Supporting Field Campaigns through Tailored Forecasting: Results from the VOLCOM Campaign at Sakurajima Volcano, Japan

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Abstract

Field campaigns are essential to advance our understanding of the Earth system. Considering their cost and the difficulty of repetition, accurate knowledge of the target phenomena is vital. Implementing dedicated dynamical downscaling during field campaigns can provide high-resolution forecast products enabling decision-making and, ultimately, increasing the chances of meeting the campaigns' goals. Here, we present a forecast algorithm that has been developed to provide tailored, probabilistic forecasts in support of any planned field campaigns that include a meteorological component. As an example, we present data from the Volcanic Emissions Observation and Modeling (VOLCOM) field campaign, carried out on Sakurajima volcano, Japan, during November 2023; chosen due to the volcano's prolonged activity (currently ongoing since 1955) and its proximity to a densely populated area (>1 million residents in the surrounding 20 km). In recent years SO_2 emissions from the volcano have been increasing, while explosive activity has been decreasing. These conditions created an excellent opportunity to carry out ground-based remote Differential Optical Absorption Spectroscopy (DOAS) observations of SO_2 to acquire model evaluation data for the forecast; here based on the Weather Research and Forecasting (WRF) and FALL3D models. SO_2 emission rates from the vent were monitored and strong signals (Slant Column Density $>10^{18}$ molecules cm^{-2}) were observed during the campaign. A comparison between the DOAS observations and the forecasted data showed good agreement, with Pearson coefficients ranging between 0.54 and 0.64 (when withholding knowledge of the emission height) and reaching 0.92 when the emission height was considered. Overall, the success of the campaign forecasts highlights the importance of increased horizontal resolution to realistically replicate the local complex circulations around the volcano, as well as scenario-based forecasting that covers the anticipated conditions.

Early Career Scientist

NO, I am not an early career scientist.

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